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THERMOGRAVIMETRIC ANALYSIS OF ALUMINOCOPIAPITE SAMPLES FOR PROFESSOR ERWIN ZODROW, COLLEGE OF CAPE BRETON, SYDNEY, NOVA SCOTIA

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THERMOGRAVIMETRIC ANALYSIS OF ALUMINOCOPIAPITE SAMPLES FOR PROFESSOR ERWIN ZODROW, COLLEGE OF CAPE BRETON, SYDNEY, NOVA SCOTIA

by

W.S. Bowman*

INTRODUCTION

Three samples of aluminocopiapite 978 GM-366, 980 GM-232 and 980 GM-302 were received from Prof. Zodrow for thermogravimetry (TG) in air. The samples were stored in a refrigerator until time of processing. They were examined as received.

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EXPERIMENTAL PROCEDURES

The samples for TG, weighing about 300 mg, were placed in a 2.6 mL platinum crucible. The thermobalance was a Stanton MF-S1 in which the crucible rests on a pedestal above the balance and is surrounded by a mullite protection tube and a platinum/rhodium-wound furnace. The gas inlets and outlets were left open to the atmosphere. Heating rate, controlled by a motor-driven cam, was 6°C/min. Sample weight and temperature were recorded simultaneously on a two-pen strip chart recorder.

RESULTS

Copies of the TG charts reduced to 60% of full size are appended to this report. The temperature vs time curve is on the right with the scale increasing from right to left. The sample weight vs time curve is on the left with the scale increasing from left to right (0 to 100 mg). To keep the pen on scale, 100 mg weights are either added or subtracted automatically causing the pen to swing from one side to the other. The horizontal lines are caused by automatic momentary arrestment of the balance every 5 minutes.

A summary of the TG results is presented in Table 1. There are two entries for sample 978 GM-366 because the temperature recording system malfunctioned during the first run. The chart and data are included because the weight measuring system seemed to be functioning normally.

The loss of water from these samples can be divided into a low-temperature stage and a high-temperature stage. The latter is presumably due to loss of OH groups. Unfortunately, the two stages overlap each other and cannot be readily resolved. The figures in Table 1 were obtained by drawing tangents to the curves and taking the point of intersection. It is realized that this practice is not ideal, but it nevertheless provides a consistent way of estimating the loss of each stage. The weight loss above approximately 400°C has been attributed to the evolution of SO_3 from the decomposition of sulphate.

Table 1 - TG results - aluminocopiapites

Sample	Weight (mg)	Total loss (%)	Total water (%)	OH water* (%)	SO_3** (%)
978 GM-366(a)	295.57	70.1	28.8	7.0	41.2
978 GM-366(b)	234.09	70.3	28.6	6.0	41.6
980 GM-232	300.96	74.5	37.1	9.5	37.4
980 GM-302	298.55	69.4	28.4	5.5	41.0

* These figures are estimates only since the weight loss due to OH overlaps the other water loss.

**Oxidation of ferrous iron may give a small weight gain that would result in low apparent weight losses for the decomposition of sulphate to SO_3.

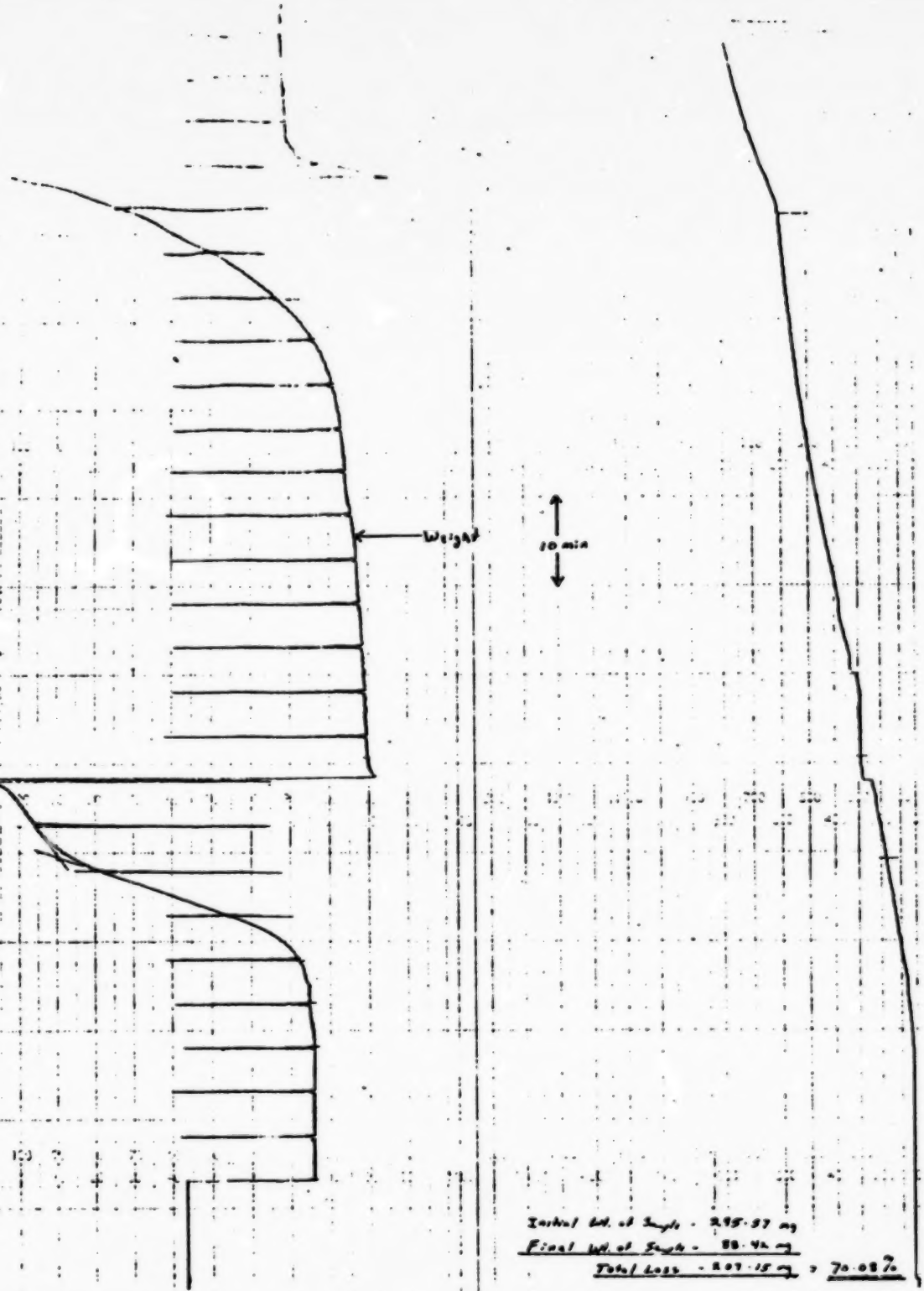
DISCUSSION

The assumed ratios for copiapite, given in Table 2, are based on the formula $XR_4(SO_4)_6(OH)_2.20H_2O$, where X = Fe^{2+}, Mg, etc. and R = Fe^{3+} and Al.

The loss of water from the decomposition of OH, estimated by the procedure used, appears to be much too high as indicated by the ratios shown in Table 2. Although other methods might be tried for the estimation of water loss from OH, they would be rather arbitrary and difficult to justify objectively. The ratios of weight loss due to sulphate decomposition to total water loss are of the right order of magnitude and probably reflect different degrees of hydration of the materials.

Table 2 - Relative weight changes due to loss of H_2O and SO_3

Sample	wt. loss, H_2O from OH / wt. loss, total H_2O	wt. loss, SO_3 / wt. loss, total H_2O
Assumed for copiapite	0.048	1.27
978 GM-366(a)	0.24	1.43
978 GM-366(b)	0.21	1.45
980 GM-232	0.26	1.01
980 GM-302	0.19	1.44



Initial Wt. of Sample - 2.95·37 mg
Final Wt. of Sample - 88·42 mg
Total Loss - 2.07·15 mg = 70.08 %

Atmosphere - Air

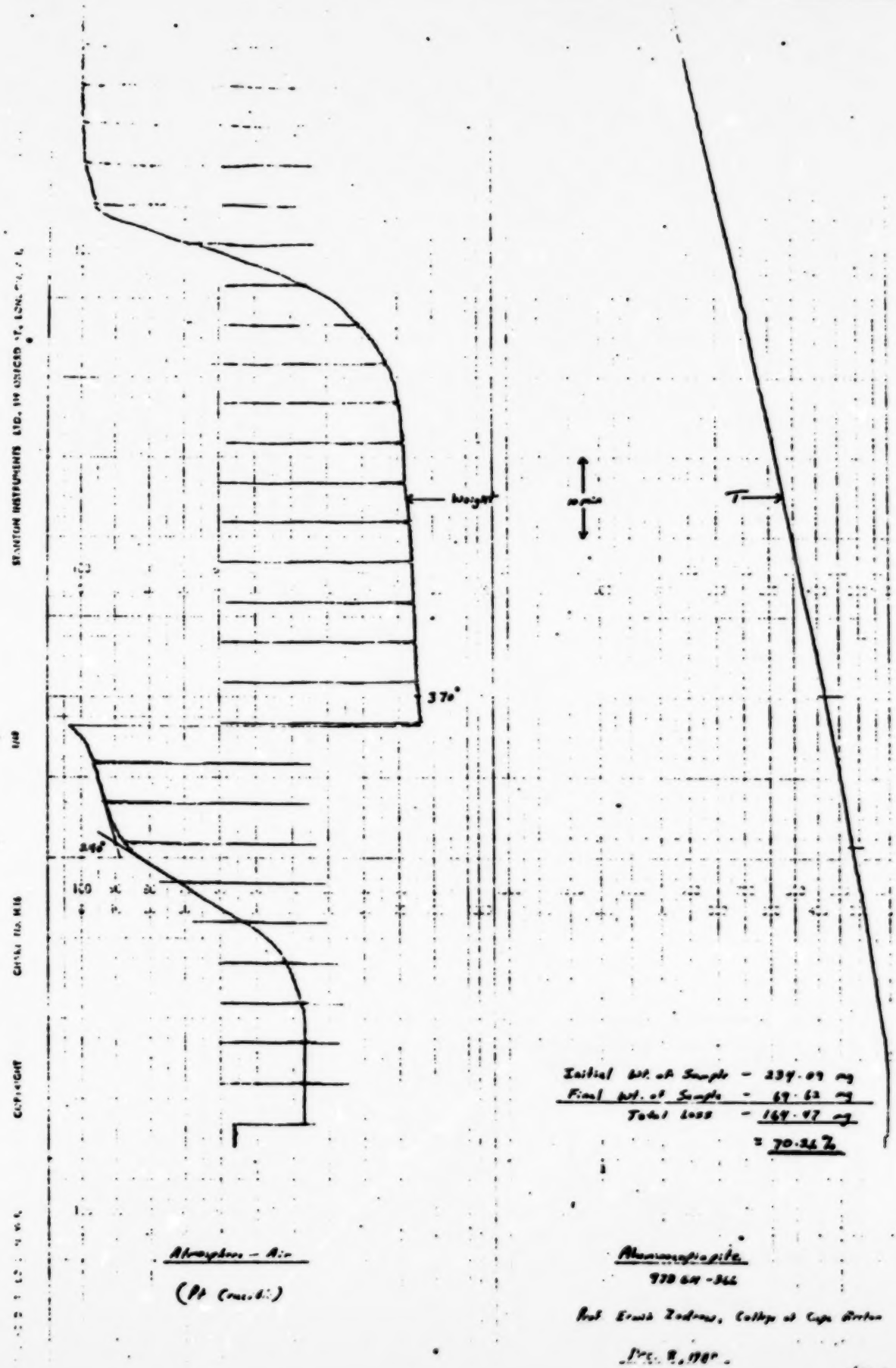
(Pt crucible)

Aluminosilicate
978 GA · 366

Prof. Ervin Zahn, College of Cape Breton

Nov 2nd, 1980

(MF)



Initial Wt. of Sample - 234.09 mg
Final Wt. of Sample - 69.62 mg
Total Loss - 164.47 mg
= 70.24 %

Atmosphere - Air

(Pt (rad.))

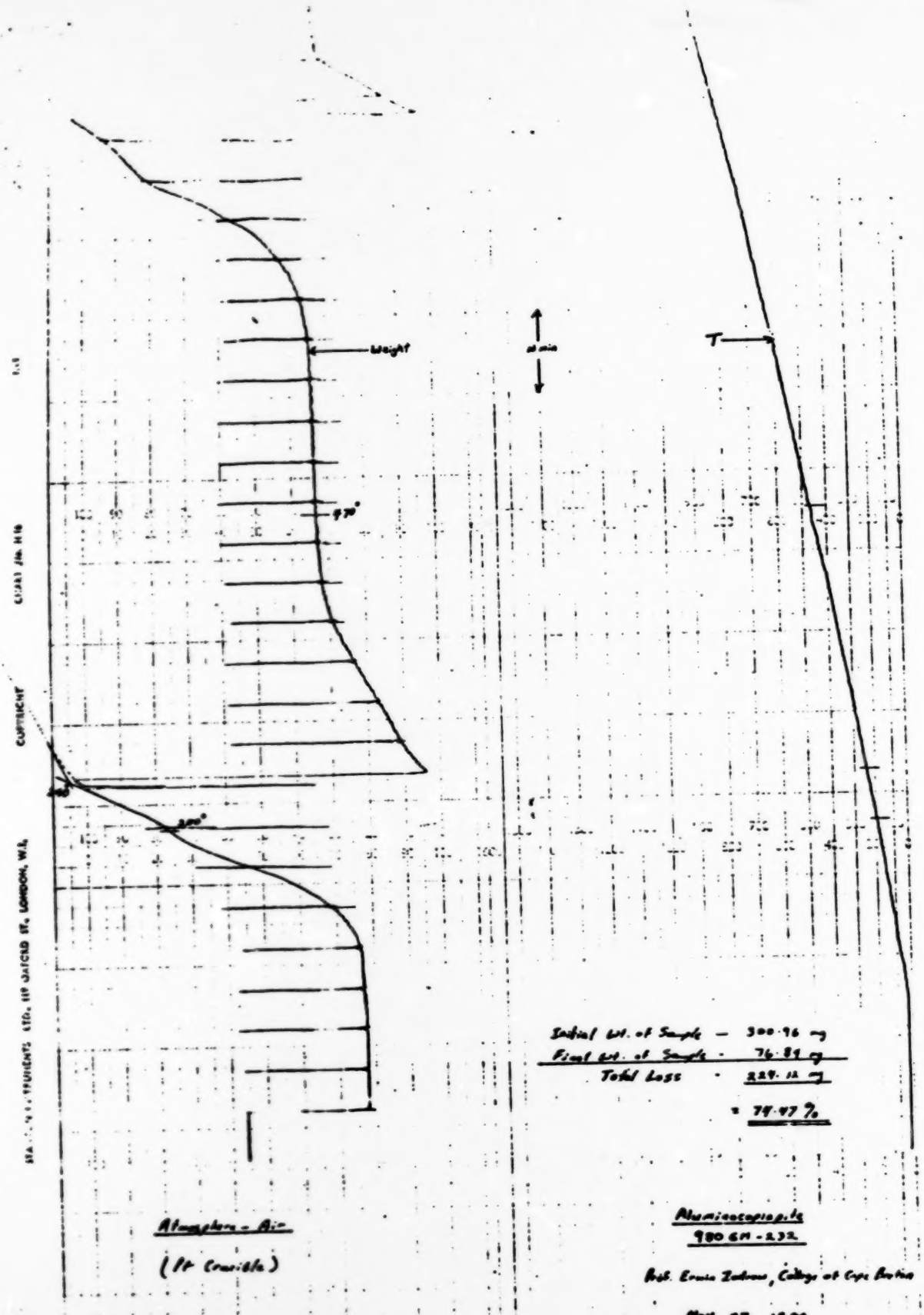
Thermogravimetric

930 64 -344

Prof Ernest Zadraw, College of Cape Breton

Dec. 8, 1980.

(11.)



Initial Wt. of Sample — 300.96 mg
Final Wt. of Sample - 76.84 mg
Total Loss - 224.12 mg
= 74.47 %

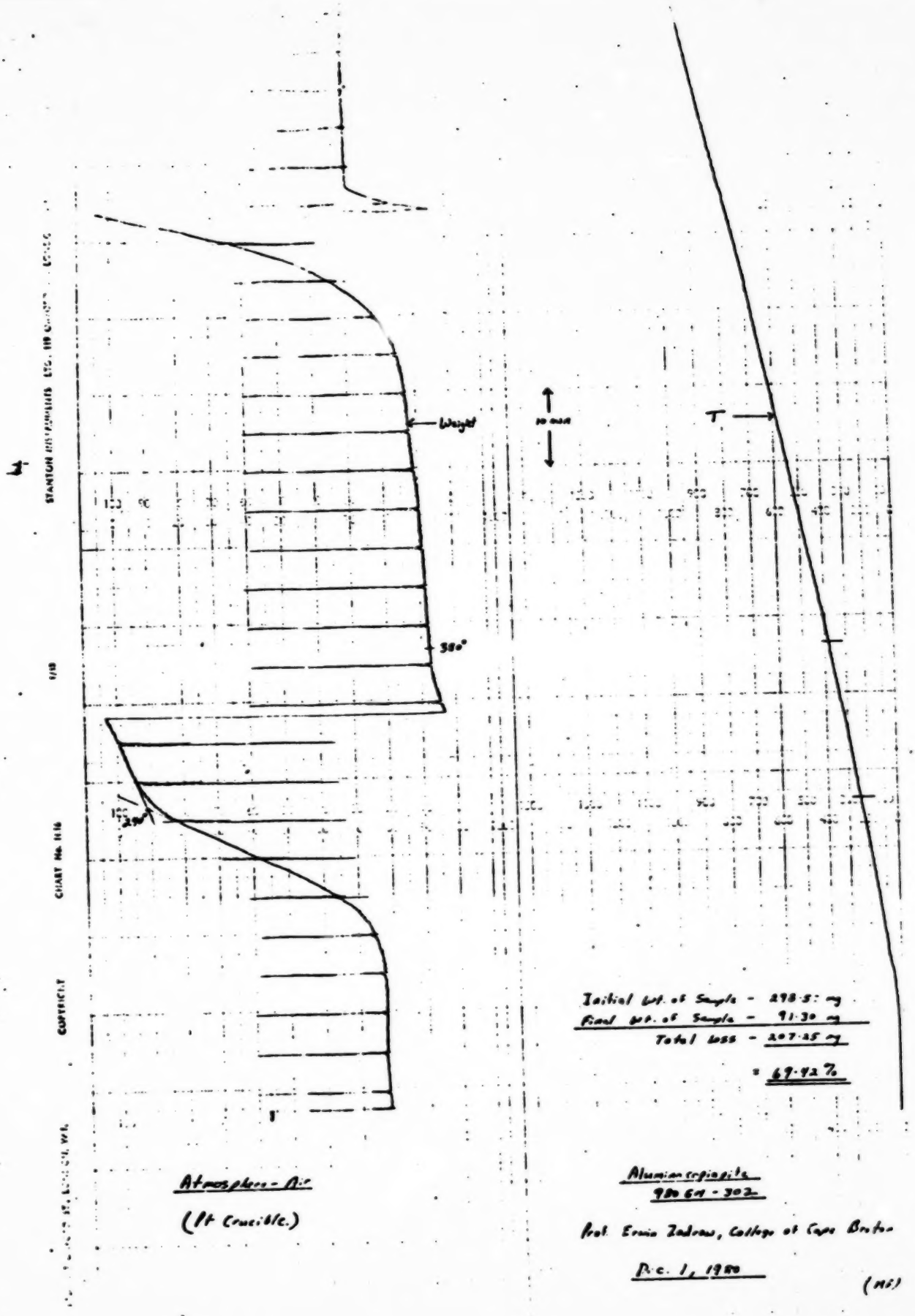
Atmosphere - Air
(Pt Crucible)

Aluminocopiapite
980 cm-1 232

Rob. Evans Zadrow, College of Cape Breton

Nov. 28, 1980

(RE)



Initial Wt. of Sample - 298.5 mg
Final Wt. of Sample - 91.30 mg
Total Loss - 207.25 mg
= 69.42 %

Atmosphere - Air
(Pt Crucible.)

Aluminosilicate
98 64 - 302

Prof. Ernie Zadrow, College of Cape Breton

Dec. 1, 1980

(M6)